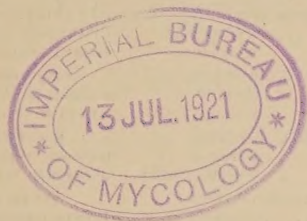


*Florence W. Patterson*

PEACH YELLOWS AND LITTLE PEACH.

M. G. BLAKE.



NEW JERSEY

AGRICULTURAL

**Experiment Stations**

226

# NEW JERSEY AGRICULTURAL EXPERIMENT STATIONS

## NEW BRUNSWICK, N. J.

### 1. STATE STATION. ESTABLISHED 1880.

#### BOARD OF MANAGERS.

HIS EXCELLENCY J. FRANKLIN FORT, . . . Trenton, Governor of the State of New Jersey.  
 W. H. S. DEMAREST, D.D., . . . New Brunswick, President of the State Agricultural College.  
 EDWARD B. VOORHEES, Sc.D., . . . Professor of Agriculture of the State Agricultural College.

#### FIRST CONGRESSIONAL DISTRICT.

EPHRAIM T. GILL, . . . Haddonfield.  
 ALEXANDER P. OWEN, . . . Mickleton.

#### SECOND CONGRESSIONAL DISTRICT.

A. ENGLE HAINES, . . . Medford.  
 FRANK E. BATE, . . . Fishing Creek.

#### THIRD CONGRESSIONAL DISTRICT.

DAVID D. DENISE, Pres., . . . Freehold.  
 JAMES NEILSON, . . . New Brunswick.

#### FOURTH CONGRESSIONAL DISTRICT.

PHILIP TODD, . . . Peapack.  
 CHARLES HOWELL COOK, . . . Trenton.

#### FIFTH CONGRESSIONAL DISTRICT.

OSDEN WOODRUFF, . . . Elizabeth.  
 ALBERT RICHARDS, . . . Dover.

#### SIXTH CONGRESSIONAL DISTRICT.

CHARLES C. BASLEY, . . . Maywood.  
 HENRY MARELLI, . . . Paterson.

#### SEVENTH CONGRESSIONAL DISTRICT.

GEORGE E. DE CAMP, . . . Roseland.  
 CYRUS B. CRANE, . . . Caldwell.

#### EIGHTH CONGRESSIONAL DISTRICT.

GEORGE DORR, . . . East Orange.  
 JOSEPH B. WARD, M.D., . . . Newark.

#### NINTH CONGRESSIONAL DISTRICT.

EDWIN RADFORD, . . . Jersey City.  
 JAMES MCCARTHY, . . . Jersey City.

#### TENTH CONGRESSIONAL DISTRICT.

FMIL BONNOT, . . . Jersey City.  
 HENRY A. GAEDE, . . . Hoboken.

#### STAFF.

EDWARD B. VOORHEES, Sc.D., . . .	Director.
IRVING S. UPSON, A.M., . . .	Secretary and Treasurer.
IRVING E. QUACKENBOSS, . . .	Clerk.
MARY A. WHITAKER, . . .	Stenographer and Typewriter.
CHARLES S. CATHCART, M.Sc.,	JOHN B. SMITH, Sc.D.,
Chemist.	Entomologist.
VINCENT J. CARBERRY,	MAURICE A. BLAKE, B.Sc.,
Assistant Chemist.	Horticulturist.
CLARENCE L. PFERSCH, B.Sc.,	ARTHUR J. FARLEY, B.Sc.,
Assistant Chemist.	Assistant Horticulturist.
LEON A. CONGDON, B.Sc.,	D. MANLEY JOBBINS,
Assistant Chemist.	Greenhouse Assistant.
LESTER H. WILLIAMSON,	GEORGE B. THRASHER,
Sampler and Assistant.	Field Assistant.
FREDERICK C. MINKLER, B.S.A.,	JULIA M. WHITAKER,
Animal Husbandman.	Assistant Stenographer.
WALTER W. SHUTE,	HARRY W. WILLIAMS,
Farm Foreman.	Janitor.

### 2. AGRICULTURAL COLLEGE STATION. ESTABLISHED 1888.

#### BOARD OF CONTROL.

The Board of Trustees of Rutgers College in New Jersey.

#### EXECUTIVE COMMITTEE OF THE BOARD.

W. H. S. DEMAREST, D.D., President of Rutgers College, Chairman, . . . New Brunswick.  
 WILLIAM H. LEUPP, . . . New Brunswick.  
 JAMES NEILSON, . . . New Brunswick.  
 HON. LOUIS H. SCHENCK, . . . Neshanic.  
 PHILIP M. BRETT, . . . New York City.

#### STAFF.

EDWARD B. VOORHEES, Sc.D., . . .	Director.
IRVING S. UPSON, A.M., . . .	Chief Clerk.
JULIUS NELSON, Ph.D.,	JOHN B. SMITH, Sc.D.,
Biologist.	Entomologist.
BYRON D. HALSTED, Sc.D.,	AUGUSTA E. MESKE,
Botanist and Horticulturist.	Stenographer and Typewriter.
B. H. ALFRED GROTH, Ph.D.,	JACOB G. LIPMAN, Ph.D.,
Plant Physiologist.	Soil Chemist and Bacteriologist.
EARL J. OWEN, M.Sc.,	PERCY E. BROWN, B.Sc.,
Assistant in Horticulture.	Assistant Chemist.
HELEN L. WHITAKER,	IRVING L. OWEN, B.Sc.,
Stenographer and Typewriter.	Assistant Chemist.

NEW JERSEY  
AGRICULTURAL EXPERIMENT STATIONS  
BULLETIN No. 226

JANUARY 11, 1910

---

**Peach Yellows and Little Peach.**

---

BY

MAURICE A. BLAKE.

---

Peach yellows and little peach are unsatisfactory and difficult subjects to discuss because their true nature is still unknown, but when the peach industry of the State is rapidly recovering from the severe losses caused by the introduction of the San José scale, it is a fitting time to urge prompt action and thorough methods in the destruction of all trees affected with yellows and little peach, for unless this matter is given serious attention by the peach growers further extensive injury to the peach industry may occur.

Peach yellows and little peach are quite similar in many particulars and may be discussed together when the matter of their control is considered. The principal difference in behavior between yellows and little peach, which has been noted, occurs in the fruit. Trees affected with yellows ripen their fruit prematurely and the color of this fruit is usually characteristically red spotted or blotched. The fruit upon trees affected with little peach remains small and is frequently a week to ten days later in ripening than on normal trees and very seldom shows any red spotting so characteristic of yellows; trees affected with little



peach seldom show the wiry, sickly shoots so characteristic of pronounced stages of yellows. It is, however, often impossible to distinguish one disease from the other in the earlier stages, especially upon young trees.

Although the true nature of these destructive diseases is unknown, there are many facts in regard to their behavior which have been established.

Valuable and extended investigations upon yellows were conducted by Doctor Erwin F. Smith, of the United States Department of Agriculture, and, although the exact cause of yellows was not determined, many important facts were learned and numerous theories in regard to yellows were shown to be erroneous.

The characteristic appearance of trees in advanced stages of yellows is familiar to most peach growers and considerable has been written upon this phase of the subject; much less has appeared, however, upon little peach and the earlier stages of yellows.

A certain percentage of the fruit growers of the State are wholly unacquainted with what is known in regard to yellows and little peach and do not know how to recognize even the advanced stages. There is an increasing demand from all the peach growing sections for information upon these peach troubles, and it is the object of this bulletin to encourage this interest among the growers by supplying an available source of information. It is also intended as a warning to orchardists to practice intensive management and to do what is possible to prevent severe premature losses of orchard trees. The writer has quoted quite freely from the writings of other investigators that the subject may be more fully covered.

### **Peach Yellows.**

Yellows has been a menace to peach growing along the North Atlantic coast for more than one hundred years. It has been especially severe in its ravages at certain periods with intervals between when but little damage has been done. At the present time it is causing more or less loss to peach growers all along the Atlantic coast to at least as far south as North Carolina. Certain localities appear to be quite free from yellows while others are thoroughly infested with it.

Some take the view that the less said about yellows the better and maintain that the discussion of it injures the industry by discouraging peach growers and others that would enter the business, but if we are to make progress in peach production we must know our problems and meet them to our best knowledge.

### **Early History of Peach Growing and First Appearance of Yellows.**

It is not definitely known just when the peach was first introduced into America, but it is believed to have been previous to 1633. For many years after its introduction it thrived and produced abundantly; very little care was given the trees and much fruit rotted in the orchards. When a new orchard was desired peach pits were frequently gathered indiscriminately and planted. It does not seem strange that something appeared as a check to this abundant production of fruit when so little attention was given to the maintenance of health and vigor.

In the vicinity of Philadelphia and along the Delaware river the peach succeeded unusually well until about 1791 when the trees began to be short-lived and to show weakness and disease, and the color of the leaves of affected trees led to the use of the term "yellows." This gradually spread through the peach orchards of New Jersey and Delaware and is thought to have reached Connecticut about 1815, but it was not reported from Canada until about 1870, and had apparently spread more slowly along the northern limits of peach production. The disease spread south through Maryland and Virginia and now occurs as far south at least as North Carolina.

### **The Nature of Yellows.**

The cause of yellows is as yet undetermined, although there are several theories held by leading investigators.

Smith writes:\* "The larger fungi are out of the question and I can think of nothing else but micro-organisms. The spread of yellows from diseased buds to healthy stocks, which I have carefully verified, points strongly to some *contagium virum* as the cause of the disease."

---

\* U. S. Dept. of Agr., Div. of Botany, Bul. No. 9, p. 179.

Another explanation of yellows is the enzym theory. Clinton writes:\* "A third explanation of yellows has been that it is a physiological disease somewhat of the nature of indigestion, due to derangement of the chlorophyll of the leaves, as it is seen in variegated plants. Such trouble is thought to be brought about by the presence of some deleterious enzym in the plant, and it is this enzym, when carried by budding from diseased to healthy stock, that causes the yellows to develop in the latter. This theory modified by the belief that it is the unfavorable weather conditions (winter freezing and summer drought) that are directly responsible for the development of the injurious enzymes or toxins, is the theory held by the writer."

Other theories which have been suggested as the direct cause of yellows are a deficiency of potash in the soil, soil exhaustion, excessive fertilization, lack of cultivation, borers and root aphids.

These theories are not now seriously considered.

We really have two theories as to the cause of yellows upon which the opinion of investigators is divided: the germ theory and the enzym theory.

Although there is this difference of opinion as to the cause of yellows, all will agree somewhat closely as to methods of prevention and control. It only differs in degree of importance whether dry summers and winter injury are finally determined to be *direct* or *indirect* factors. In either case it is important that we prevent winter injury to the trees in any way possible.

It is also certain that trees unquestionably affected with yellows steadily lose vigor and are soon worthless. Even those trees which bear some fruit for a few years are a detriment to the industry, as the indifferent flavor of the premature fruit and its poor market qualities cannot but injure the demand of both commission men and consumers, and such trees had best be destroyed in the beginning. That it is also probable that they may infest healthy trees in the same orchard or vicinity is another reason for their prompt destruction. The disease usually appears at one or more points in an orchard and spreads from these centers.

The writer believes that the so-called "outbreaks of yellows" are due in no small degree to the lack of watchfulness and careful orchard management on the part of peach growers and nurserymen.

---

\* Rpt. of Conn. Agr. Expt. Sta. 1907-1908, p. 877.



Immediately following widespread damage by yellows the number of living affected trees is much reduced and many poorly managed orchards disappear. For a time the growers are fully awake to the danger of yellows, affected trees are destroyed and better orchard management is practiced. In succeeding years, however, there is decreasing vigilance as yellows apparently subsides.

Men inexperienced in fruit growing and often wholly unacquainted with even the advanced symptoms of yellows are frequently entering the business of peach production. This is especially the case in years following high prices and these result after any severe reduction in the number of bearing trees.

Yellows gradually gains a foothold unmolested; finally, conditions especially favorable for the disease occur and we have another outbreak.

The writer is led to these conclusions by a study of past and present conditions of peach orchards in certain localities. Where the growers are unfamiliar with the symptoms of yellows, and where there is decided objection to the destruction of "yellows" trees, there we find yellows established. As may be inferred, such localities also fail to practice the better general orchard management. It should not be concluded from this, however, that yellows never occurs seriously in well managed orchards, but it is less likely to happen.

#### **Symptoms of Advanced Stages of Yellows.**

One of the most prominent symptoms of yellows is the premature ripening of the fruit. Affected trees may ripen all or only a portion of their fruit from a few days to several weeks in advance of the normal season of ripening. The prematurely ripened fruit almost invariably has a characteristic appearance which a careful observer can detect. Instead of uniform masses and blending of color the fruit has a red spotted or blotched appearance; these red spots or blotches may be few or numerous and occur largely near the surface or through the flesh to the pit. The flesh surrounding the pit is also usually much more red than in normal fruit. An illustration of premature fruit is shown in Fig. 1. In some instances affected trees produce fruit which is very highly colored and the red spotting is almost obscured. Specimen fruits will sometimes be found upon diseased trees which fail to show the characteristic red spotting although the flesh about the pit will

usually indicate yellows. Sometimes only one branch of a tree will apparently be affected and while the fruit upon this affected branch is prematurely ripe the fruit upon the remainder of the tree will be entirely green.

The flavor and quality of the premature fruit is somewhat variable. When it ripens several weeks in advance of its normal season it is usually under normal size, watery fleshed, insipid and sometimes bitter. When the fruit ripens at about the normal time, however, it may be of fair quality. Such fruit usually occurs upon trees which have apparently been affected only for a short time.

Peach trees sometimes produce premature fruit because of girdling by borers or other injuries, but such cases can readily be determined from yellows.

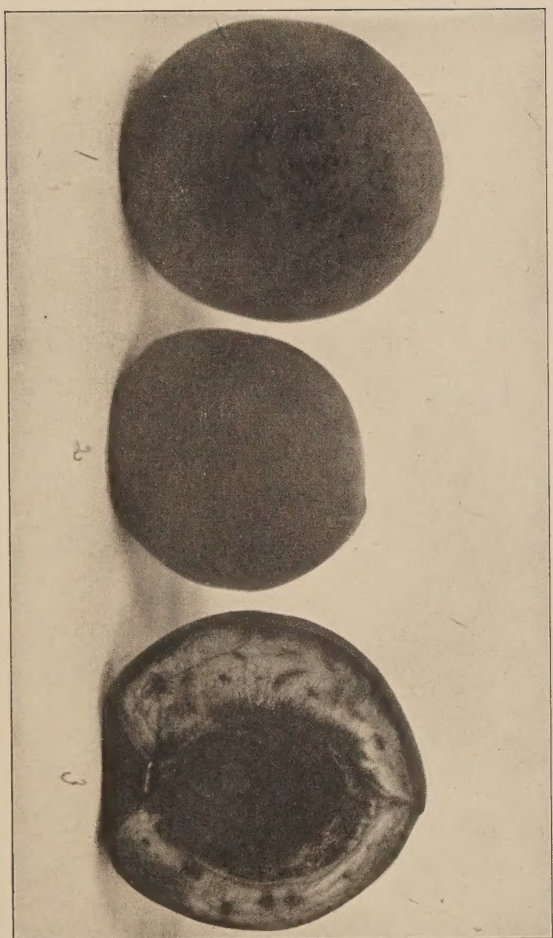
The premature fruit caused by yellows is very susceptible to the brown rot and decays rapidly under conditions favorable to that disease.

Another prominent symptom of yellows is the characteristic development of slender, wiry, yellowish-green shoots upon the trunk and lower branches of affected trees. The leaves upon these shoots are smaller and more narrow than upon healthy twigs besides having a starved, sickly, greenish-yellow appearance. These symptoms are illustrated in Figs. 2 and 3. The characteristic shoots sometimes develop at the tips of branches as well as upon the trunk and lower limbs. In some instances, only a few of these slender, wiry shoots are produced on each tree while in other cases they push out over the entire tree. Affected trees can often be detected in the dormant season by this wiry twig development. Twigs Nos. 1 and 2 in Fig. 4 were cut from a yellows tree in December, and indicate how the disease may sometimes be detected in winter. Occasionally these wiry twigs will make a late fall growth and retain leaves for a time after the other branches are dormant.

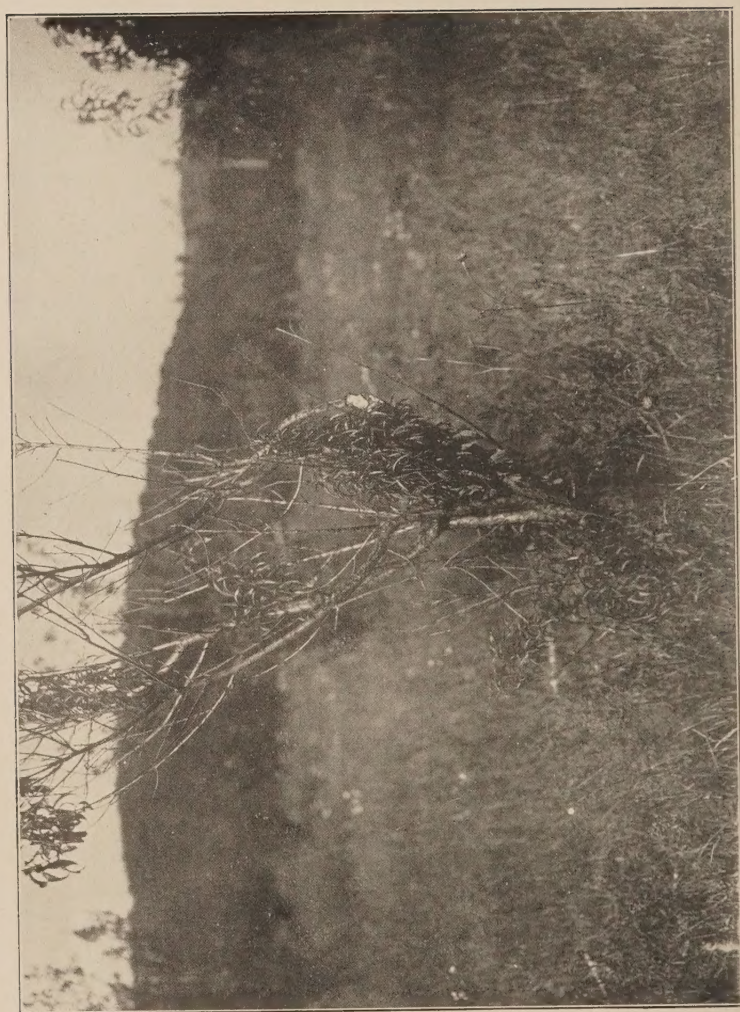
In advanced stages of yellows the premature red-spotted fruit and the weak, sickly appearing shoots are commonly found upon each tree, but in the earlier stages the red spotted premature fruit may appear first and in other cases the slender shoots.

Trees affected with yellows commonly have a sickly, yellowish-green appearance, and the diseased trees in an orchard can be detected from a distance because of this. Diseased trees may appear a healthy green, however, if there is a liberal supply of available





**Fig. 1.** Nos. 1 and 3 illustrate premature peaches from yellows trees. No. 2 is a specimen of little peach. Note the red spotted effect upon the surface of No. 1 and through the flesh of No. 3.

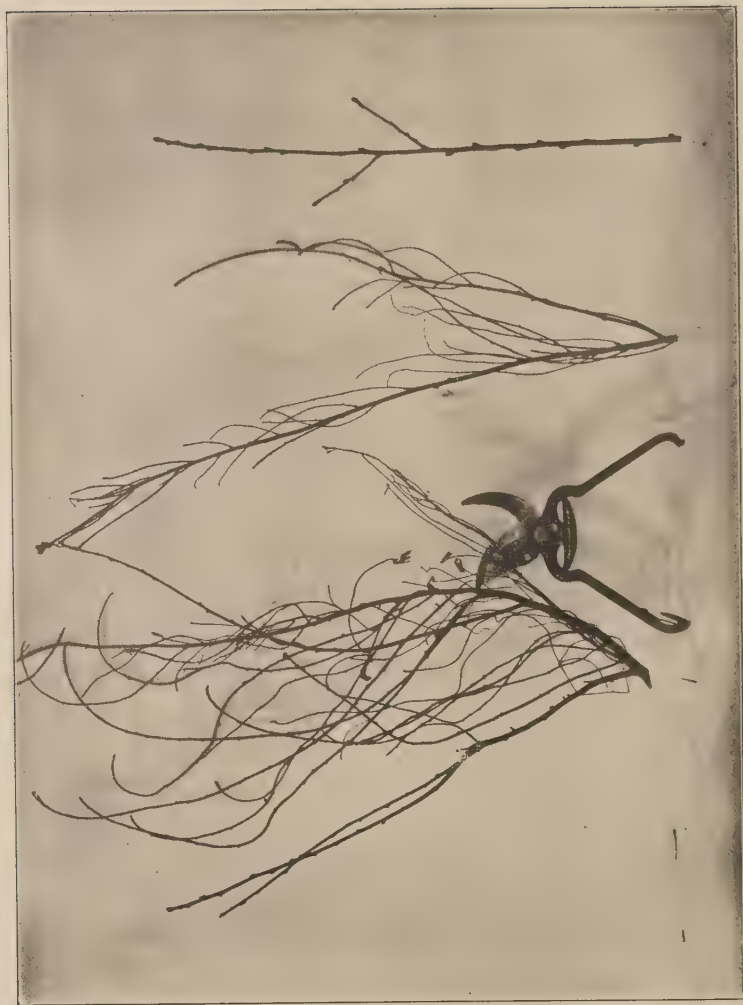


**Fig. 2.** A peach tree in the last stages of yellows. The characteristic yellows shoots are now the only portions of the tree showing life. Note the appearance of the leaves upon these shoots.



**Fig. 3.** A two-year-old peach tree showing unmistakable symptoms of yellows. Note the finely branched shoots with narrow leaves in the center of the tree.





**Fig. 4.** Twigs Nos. 1 and 2 were cut from a peach tree in advanced stages of yellows. Note the tendency to the production of a large number of weak branches. These would have the characteristic narrow yellowish green leaves if photographed in summer. Twig No. 3 was cut from a healthy tree for comparison.



**Fig. 5.** Young patch tree at High bridge with one main branch affected with yellows. Note rolled appearance of leaves upon upper of diseased limb. Compare with Figs. 6 and 8.



**Fig. 6.** An illustration showing the rolled leaves upon a young peach tree in late summer as a result of previous winter injury to the bark of the main root just below the collar. This same appearance may be brought about by yellows, borers, and severe mechanical injury or girdling.





**FIG. 7.**

An illustration of the same trees as in Fig. 6, photographed later in the season. When the leaves fall in late summer the buds mature earlier and the leaves fall before those upon normal trees. Note the large size of the fruit buds upon this tree. These will bloom earlier next spring than buds upon normal trees.



Fig 8. An illustration of peach tree girdled by a label wire at (1). The leaves above the girdle rolled in late summer, the fruit prematurely and it was noticeably bitter. The branch (2) was not affected by the girdling and the foliage and fruit behaved normally.

nitrogen and moisture. During the months of May, August and September the foliage of affected trees is usually more yellow in color. When the trees are growing more rapidly in June and July, however, the leaves are a darker green and have a more healthy appearance.

**Symptoms of Early Stages of Yellows in Young Trees Previous to Bearing.**

Much has been written upon the subject of peach yellows, but it has been largely concerned with the prominent or advanced stages of yellows. In the control of yellows by the destruction of affected trees it is of much importance that diseased trees be detected at as early a stage as possible. Very few peach growers recognize an early stage of yellows and unless the prominent or advanced symptoms appear the trees are considered to be healthy. Since the establishment of the two experiment orchards by the experiment station the writer has been able to closely observe the behavior of a large number of peach trees, and the peculiar behavior of some trees has been of especial interest (see Figs. 13 and 14), because all factors such as fertilization, cultivation and pruning have been known from the beginning.

Yellows may first make itself apparent in various ways and this is more easily explained if we first discuss its appearance in well fertilized and well managed orchards. A young, healthy peach tree which is growing properly will have a rich dark-green foliage. If the leaves of one branch of such a tree begin to turn a yellowish-green or have a reddish, rusty-green appearance and roll from the edges it indicates a checking of the growth of that branch. *If no insect or mechanical injury has occurred to the branch it strongly indicates yellows.* See Fig. 5. The leaves upon such a branch ripen early and fall while the remainder of the tree retains most of its foliage. The fruit buds will be larger and further advanced upon the affected part and the bark will have a riper appearance with noticeably larger lenticels. This change in the behavior of any part of a well cultivated young peach tree does not usually occur until August in New Jersey and sometimes not until September. Where only a portion of a tree behaves in the manner described it is not very difficult to diagnose the cause, but if a whole tree stops its growth earlier than other trees surround-



ing it and the leaves become rolled the matter is not quite as simple. Trees which are severely injured by borers, mechanically girdled, or have had the bark winter-injured just below the collar may also have this same appearance as illustrated in Figs. 6 to 9. However, if the bark of the root shows no winter and mechanical injury and borers have caused but little or no damage, and especially if surrounding trees are growing normally, it is a strong indication of yellows. If a tree should be set in very shallow soil with underlying rock a severe drought might cause a rolling of the leaves and this matter should be considered in some localities, but such cases can be determined by examination.

Several cases of early stages of yellows appeared among three-year-old trees in the experiment orchard at High Bridge, in the late summer of 1908. Two trees were left standing to note their behavior in the spring of 1909. The trees went into the winter with the fruit buds in a more advanced condition than those upon normal trees and as would be expected bloomed earlier from several days to nearly a week. The leaf buds also pushed out earlier than upon normal trees. Later in the season the characteristic yellows shoots developed as well as premature fruit.

Yellows may first indicate its appearance in a different manner from that already described. Instead of a rolling of the leaves of the whole branch or of the whole tree, the leaves in the center of a tree may turn yellowish-green and roll slightly from the edges toward the midrib. They may also droop downward toward the trunk to some degree. See Fig. 15. This yellowing and rolling of the leaves may extend well out towards the tips of the branches or be confined to the center or lower parts of the tree. These affected leaves are often shorter and smaller than under normal conditions as illustrated in Fig. 16. In some cases the inner leaves which tend to roll and droop are better described as a lighter green than normal leaves rather than a yellowish-green. The rate of growth of the tree is probably a factor in determining the color; this was true of certain affected Mountain Rose trees at High Bridge which had received nitrate of soda. The yellowing, rolling and drooping of the leaves in the center of the tree is more often an early indication of little peach in the experience of the writer, but it may also indicate yellows. At this stage it is impossible to definitely determine whether it is a case of yellows or little peach, unless the tree is producing fruit when it can be read-

ily determined. Such a distinction is not important to the practical growers, however, as the tree should be destroyed in either case.

Instances have also been observed by the writer of young trees whose entire foliage became slightly yellow in color during the late fall. This difference was so slight that it would easily be overlooked or if noticed assigned as caused by the normal ripening of the tree for the winter's rest. The following spring, however, indications of something more serious soon appeared. The fruit and flower buds pushed out in advance of normal trees, the new leaves remained a yellowish-green and finally unmistakable symptoms of yellows appeared. These observations indicate that yellows may occur in an orchard some time in advance of the appearance of what is termed the true symptoms. Growers complain of sudden epidemics of yellows when the trees are four to five years of age. The disease has often been previously present in such orchards and has developed unnoticed until a crop of premature fruit brings it emphatically to the attention of the grower. *One cannot correctly determine the exact number of new cases of yellows appearing each year by annually going through an orchard and counting the prominent cases:* it means careful observation of every tree during the late summer and fall months.

The advanced symptoms of yellows appear more prominently in affected trees when the vegetative growth is checked by a crop of fruit, by lack of cultivation or by any other factor which checks the growth of the trees. *New cases are not infrequently incorrectly ascribed to certain years because the earlier stages were not detected.*

Early stages of yellows are more difficult to determine in neglected or poorly-managed orchards as the foliage of all the trees may be off color. The prominent symptoms, however, appear earlier. It may be said that it would require an expert to determine cases of early stages of yellows. This is true in many instances and inspectors should be supplied by each State.

Upon bearing trees yellows may first appear in the form of premature fruit upon one branch or over an entire tree. The foliage of the tree may be a healthy dark-green even after the fruit has prematurely ripened, the only evidence of anything out of the normal. In such cases one is led to believe that the infestation was comparatively recent to the premature ripening of the fruit.

### Are Peach Yellows and Little Peach Distributed by Means of Nursery Trees?

This question is frequently asked by peach growers and calls forth a considerable difference of opinion wherever discussed. Observations seem to indicate, however, that to a certain extent at least there is danger from this source. Smith has shown\* that buds taken from an apparently healthy branch of a diseased tree and inserted in nursery stock will almost invariably produce yellows. If an apparently healthy branch may carry infection, may not a healthy tree do so in some instances? This indicates that infection can be carried by means of buds where the disease may be unsuspected.

In the experiments at High Bridge measurements of annual growth were taken each year and from the beginning it was noticed that three trees were not making a normal growth. The trees did not grow as rapidly as normal trees and were off-type for the variety. This difference continued to increase each year, and the past spring the fruit and leaf buds pushed out in advance of normal trees. They bore fruit for the first time during the season of 1909, and two trees showed unmistakable symptoms of little peach and one of yellows. The evidence is not conclusive, but it is very strong that these trees were affected when they left the nursery.

Two trees showed early stages of little peach or yellows at Vine-land at the beginning of the third summer's growth and were immediately destroyed. The writer has observed quite a number of young peach trees in various parts of the State from *one to two years old* (see Fig. 3) that were affected with either little peach or yellows and although it is unlikely that all of the cases came from the nursery the evidence is very strong that some of them did.

In other instances where an orchard has been set with trees procured from several different sources, yellows and little peach have appeared *the second or third summer in only certain lots*.

Phillips states:† "One case came under my observation in 1907, where five trees in a lot of 350 purchased and planted in the spring of 1905, developed the disease during the next two years. The conditions were such as to leave no doubt that the contagion came in the nursery stock.

\* U. S. Dept. of Agr., Div. of Veg. Path., Bul. No. 1, 1891.

† Address before American Nurserymen's Association, Milwaukee, Wis., June 12th, 1908.



"Another case where trees were planted in the spring of 1907 and examined June 8th, 1908, seven trees in 540 showed symptoms of yellows. This orchard stands adjacent to other orchards in which diseased trees have developed, but are destroyed promptly. Another orchard on the same farm, but quite distant from this one and fully one-half mile from any diseased trees, was planted in the spring of 1907 and examined June 8th, 1908. In a lot of Salway, one was found to be affected with yellows, and, in a lot of 243 Smock, six were found to be affected.

"We have just seen that nursery stock grown from buds taken from the healthy portion of diseased trees is not likely to show symptoms of yellows the first season. How much more unlikely is it for contagion to spread from adjoining orchards and show up in the trees at the beginning of the second year!

"The above facts prove conclusively to my mind that the contagion comes into the nursery both through the pits and the buds used in propagating nursery stock."

There is some difference of opinion as to the danger of using pits from trees affected with yellows in the propagation of nursery stock. It is quite certain, however, that the pits from peaches which mature considerably in advance of the normal season are very weak in vitality and that very few or none germinate. On the other hand, however, affected fruit which ripens at about the normal period may have well developed pits and this is true of the apparently healthy fruit on trees of which some branches are diseased. The writer has germinated pits from such sources the past season but it is yet too early to determine whether or not they will produce yellows trees.

Phillips states\* in regard to this question: "I have so often observed seedlings growing under trees badly diseased with peach yellows as to make me confident that a few diseased pits germinate. Actual experiments, made during the past eighteen months, also show that at least a small per cent. of the pits from premature peaches taken from yellows trees germinate. In one case, four out of thirteen seedlings showed symptoms of yellows at the end of the first growing season. In another case nine out of eighteen produced seedlings that showed symptoms of yellows; though 414 pits were planted to get the eighteen seedlings, enough of them were

---

\* Address before American Nurserymen's Association, Milwaukee, Wis., June 12th, 1908.

diseased to infect the nursery. At a recent examination, several of these seedlings were found to be dead, yet there were several more which showed decided symptoms of yellows."

There is wide variation in the quality of peach pits as now procured through commercial sources. The writer secured pits from a certain source in the fall of 1908 and their behavior strongly indicated that they were from premature fruit. Very few of these pits germinated. It is believed that our whole system of peach propagation will need attention in the future when this matter of peach yellows is cleared up.

Small lots of trees are sometimes grown by those who know very little about peach diseases. An instance recently came to the attention of the writer where buds of questionable health were used with the result of a percentage of diseased trees at the close of the first year after planting.

One instance of growing peach trees between the rows of trees in a peach orchard, as illustrated in Fig. 11, has been observed. This is a questionable practice from several standpoints.

Weak trees in orchards appear to be more susceptible to yellows than normally vigorous trees, and weak, poorly grown nursery trees should not be planted. It is for the best interests of the nurserymen to grow vigorous trees free from disease.

#### **Is the Effect of Yellows Caused by an Interference With the Normal Nutrition of Trees?**

In studying the symptoms of yellows one is led to inquire, What plant functions are interfered with that produce premature fruiting, the development of the slender, wiry shoots and the rolling of the leaves in certain cases? *Conditions which resemble the symptoms of yellows to some degree can be produced upon healthy trees by interference with the functions of the cambium layer.*

The premature ripening of the fruit may be induced by girdling. It will not be characteristically red spotted as in the case with yellows, *but the flavor will be more or less insipid and bitter* according to the severity of the check to the flow of sap. The fruit upon the girdled tree may be of unusual size, but the check to the downward circulation of sap is probably greater than in most cases

of yellows, although in certain cases of yellows there is sometimes an unusually large development of the fruit.

*Weak, sickly appearing shoots with narrow leaves* will sometimes appear upon the trunks of young peach trees below a point where they have been girdled by a label wire. This is more likely to be the case where the girdling occurs below all side branches and causes a starvation of the trunk below the girdled point.

The rolling of the leaves followed by early maturity and falling, indicating early stages of yellows in some cases, also invariably occurs when a tree is girdled. See Figs 6 to 9. The fruit buds mature early in both cases and bloom earlier in the spring than buds upon normal trees because of the fact that they were farther advanced before the beginning of winter and that less heat is required in the spring to bring them to the blooming stage. Early maturity of fruit buds in the fall is caused by a checking of the vegetative growth of the tree. When the vegetative growth is severely checked by girdling or by yellows the fruit buds become unusually large before winter.

The exact symptoms of yellows cannot be produced by ordinary girdling, but conditions can be produced very similar to yellows by such practice. It may be doubtful whether the symptoms of yellows are directly caused by a checking of the functions of the cambium layer, but observations strongly indicate an interference of some sort with the downward translocation of plant foods. The indirect effect of such factors as lack of cultivation, dry seasons, fruit production and insufficient fertilization upon early stages of yellows tend to strengthen this theory. Whether the interference with translocation is caused by the action of an enzyme or a germ appears to be the unsettled question.

#### **Influence of Lack of Cultivation, Fertilization, Overbearing, Borers, Leaf Curl and Scale.**

Nearly all of the above-mentioned factors have been associated with the cause of yellows at various times, but these views are believed to be erroneous—indirectly, however, they may have considerable influence. Anything which tends to reduce the vigor of a peach tree affected with yellows serves to bring out the symptoms of the disease more prominently. A tree showing early stages of



yellowes may be quickly reduced to an advanced stage by neglect of all cultivation and care.

Fruit-bearing, lack of cultivation, fertilization and moisture, borers, root aphids and scale may all reduce the normal vigor of the peach tree. If yellowes is a form of mal-nutrition, these factors should increase the prominence of the symptoms, and such is the case. *Severe winter pruning and liberal applications of available nitrogen tend on the other hand to make a yellowes tree appear more healthy and vigorous, but it only masks the true state of affairs and does not effect a cure.*

Yellowes has appeared to spread more rapidly in orchards that lack care and attention and where the trees are much weakened from any cause, and peach growers should guard against any such condition of their orchards.

### **Winter Injury.**

It is the opinion of some that winter injury is the direct cause of yellowes.

There are several forms of winter injury to the peach. One of the milder forms is the killing of the fruit buds by low temperatures. A more severe form occurs when the twigs are actually killed back in addition to the destruction of the fruit buds. Injury of this character seldom occurs in New Jersey upon healthy trees, and the fruit buds of the peach are seldom winter-injured in central and southern New Jersey. The injury which does occur is largely due to late spring frosts and unfavorable weather conditions.

Still another form of winter injury occurs to the bark of the trunk just below the surface of the ground. Severe cases of this sort of injury have been observed by the writer where the soil was dug away from the trees in fall for the removal of borers and not put back until spring. The freezing and thawing conditions of winter severely injured the bark. Nearly all of the trees bloomed, leaved out and set fruit and then gradually began to die. Only a small percentage of the trees survived. The severity of such injury varies considerably, however, with the soil conditions and the character of the winter weather.

The same sort of injury to a less degree quite frequently occurs in orchards even where the soil is not removed from the base of the tree in the fall. High winds sway the tree about causing a

hole to be opened around the trunk at the base which exposes the tender root-bark below the collar to the winter weather, and, not infrequently, the soil is pushed away from the tree so that one can look down between the soil and the tree to a depth of from ten to twelve inches. If it is a retentive soil, moisture collects about the main trunk root at certain periods and the freezing and thawing cause some injury.

Unless severely damaged the trees may fail to show any injury at the beginning of the growing season, and it is usually not apparent until after the favorable growing weather of May and June and perhaps a portion of July is past. But with dryer conditions of soil and an increasing demand for moisture by the enlarging fruit the trees show a weakness by a more dull appearance of the leaves followed by rolling. See Fig. 6. The fruit may also ripen in advance of the normal season, is usually of large size, but poor flavor and is often bitter. An examination of the root sometimes reveals dead portions of bark and that which is alive is spongy. This winter injury has reduced the ability of the cambium layer to carry out its functions to support the tree in its season of greatest need and the fact is made apparent by the rolling of the leaves and the forced ripening of the fruit.

The fruit upon such winter-injured trees as has been described is sometimes of unusual size. No red spotting occurs as is the case with yellows, but it can always be distinguished by its appearance from fruit grown upon uninjured trees, and if it matures much in advance of the normal season it is quite bitter.

Much more injury of this character has been observed by the writer in New Jersey than in the New England States. This may possibly be explained by the fact that the winters in New Jersey are more open and variable than those of New England.

*The leaves upon girdled trees, winter-injured trees and trees in an early stage of yellows may all have the same rolled appearance, may drop their leaves early, mature their fruit buds to above normal in the fall and bloom earlier in spring, and the real cause can only be determined by an examination of conditions. See Figs. 5 to 10, inclusive.*

This type of winter injury is more frequently observed upon young trees from one to five years after planting. It often occurs upon the loamy soils of Hunterdon county, especially if such soils are "springy" or wet.

A certain form of winter injury may bring about a condition of the tree which quite closely resembles yellows, and this is induced by the partial or complete girdling of the main root which directly interferes with the nutrition of the tree.

Trees in low, wet places are known to be more susceptible to yellows and trees in "springy" portions of Hunterdon county orchards are noticeably so. To the writer, winter injury appears to play at least an indirect part in the development of yellows in some localities.

It is possible that a germ disease affecting the functions of the cambium layer might prove more severe in its ravages if the cambium was also weakened by winter injury.

Although we do not know the cause of yellows we do know of the damage caused by winter injury and of the danger that may directly or indirectly result from it. The writer has observed young orchards the past year which were more severely damaged by winter injury to the bark of the main root than most orchards in the same locality were by yellows.

Winter injury is more likely to occur upon the heavier soils of the northern half of the State, and especially where the orchard site is severely exposed, but sometimes it occurs even upon the sandy soils. Fields with low or wet sections should not be set to peaches. To guard against winter injury under all conditions it is best to mound up the soil slightly at the base of the trees just before freezing weather in the late fall; this will turn water away from the base of the tree and is a good protection against winter injury.

#### **Little Peach.**

This disease has been known for only a comparatively few years. There is some doubt as to where it first attacked the peach. It was previously believed that it first appeared in Michigan some fifteen years ago, but some later observations indicate that it possibly occurred at as early a date in New York State. The source from which the disease came is not known, but Waite has suggested that it may have been introduced with Japanese plums. It is not known when the disease first appeared in New Jersey, but cases were found at Marlton and at Vineland several years ago. The disease is now widely distributed over the State and in some orchards is causing more damage than yellows.



The cause and true nature of little peach is still unknown, but it is apparently of the same general nature as yellows although distinct from it. A few orchards have already succumbed to the disease in New Jersey and little peach is to be regarded as seriously as yellows by all peach growers, and affected trees should be destroyed as soon as they are detected.

One of the most prominent symptoms of little peach is the behavior of the fruit. Instead of ripening normally, or prematurely, as is the case with yellows, it remains under size and does not ripen until about ten days later than normal fruit. The flavor of such fruit when ripe is inferior and in some cases it is decidedly insipid and watery, but it may be as high colored as normal fruit. The flesh appears to be somewhat "stringy," at least with early clingstone varieties.

In connection with the appearance of the fruit the appearance of the leaves is a prominent indication of little peach. *The foliage may vary from a lighter green than normal trees to a decidedly yellowish-green*, but the leaves at the base and through the center of the tree will have a rolled and drooped appearance. When the tree is severely checked all the leaves will have this appearance. Trees in certain stages of yellows may also have a similar appearance and unless the trees are bearing fruit it is almost impossible to distinguish any difference. *However, this appearance of the leaves once carefully observed is not likely to be confused with anything except yellows or little peach*, and this is sufficient from a practical orchard standpoint. The writer has not observed any trees in the early stages of little peach whose foliage at the tips of branches rolled in the manner of certain cases of yellows described upon page 9, and there has appeared to be no prominent forcing of the size and maturity of fruit buds.

#### **Early Stages of Little Peach.**

Under the subject of yellows the danger of the distribution of yellows and little peach by means of nursery stock was discussed. Whether trees are ever affected with little peach when delivered from the nursery is somewhat in doubt, but there is some evidence to indicate that such is sometimes the case. Observations of the behavior of young orchard trees from the time of planting is of interest in this connection.

As stated previously, a few of the young trees in the orchard at High Bridge failed to make a proper growth from the beginning and there was no apparent reason for this. The trees which developed true symptoms of little peach the past season have had a noticeably upright habit of growth from the beginning, much more so than the normal habit of the variety. Fig. 14 illustrates a Mountain Rose tree which has not grown normally since it was set and which developed little peach the past season (1909). The growth is decidedly upright and the twigs are short and numerous. The upright habit of growth may not be characteristic of the disease and may be due directly to the slower growth made by a young affected tree. The writer has observed a number of such instances, however, in a number of orchards where the younger trees were apparently affected from the beginning. Older trees with their habit of growth already formed before showing symptoms of little peach have not been observed to show this uprightness of growth.

The past season, the writer examined a number of pits from trees affected with little peach to note their vigor. These pits were much smaller than normal pits and did not appear capable of germination. They were collected from trees which matured their fruit ten days later than normal trees.

#### **Decline of the Trees.**

After orchard trees once develop a crop of affected fruit they are of no further value to the grower. They may produce another partial crop of fruit and perhaps more than one, but it is of no value. If some should be presentable enough to be sold at a low price, it could but injure the demand.

In general the trees rapidly decline in vigor; if any fruit is produced it becomes smaller and poorer and the trees die back and finally succumb. The quality of the soil and the amount of cultivation and fertilization given the trees influence to some degree the rate of decline.

In New Jersey the disease has appeared to spread through the orchards more rapidly than yellows and is as much to be dreaded.

Allowing the trees to remain after they are once affected increases the danger to young orchards and does not benefit the grower in any way. It cannot reflect any credit upon his reputa-

tion as an intelligent practical grower to allow these sick trees to remain standing and slowly decaying. Such conditions also offer a favorable opportunity for insect enemies to increase.

**Laws for the Destruction of Trees Affected with Yellows and Little Peach.**

The question arises as to whether legislation for the destruction of trees affected with yellows and little peach is desirable and necessary.

In some localities, peach growers are prompt in destroying all affected trees and the problem is largely disposed of. But in other instances there are those who object to the destruction of a single tree in their orchards even if such a tree should be nearly dead with disease. A small amount of money is not infrequently secured from the sale of premature fruit and, while such revenue occurs, no argument is strong enough to secure the destruction of the trees. The orchards of a thorough, practical grower may be continually menaced if he has a near neighbor of this sort.

There are also those who are agreeable to the practice of approved methods, but who lack experience in determining cases of yellows and little peach and who are unwilling to trust to the judgment of those equally inexperienced.

There is still another class who have only a few peach trees and who are not engaged in commercial fruit growing. Many of this class are not concerned with plant diseases and do not realize the importance of their control.

The foreigner settling in the midst of our peach sections composes still another class to be thought of. Many of the latter are men entirely ignorant of American methods of orchard management.

The horticultural division of the experiment station is continually receiving requests from fruit growers to visit their orchards and determine the health of their trees, and there appears to be an urgent demand for a trained inspector.

It would seem from a theoretical standpoint that legislation requiring the destruction of diseased trees determined by competent inspectors would be the best solution of the problem. Such required destruction should tend to promote the practice of better methods of orchard management.

If the peach industry of the State is to be placed upon a strong basis there must be organized and thorough eradication of yellows and little peach, and where this is carried out, together with good orchard management, we can hope to reduce the loss from yellows to a low point.

Eradication tests have been made at various times, and Waite writes:\* "In general it may be stated that from the eradication tests where careful records have been made over a considerable area, and from the experience of the best worked orchards, of which there are a large number in Michigan, and a good many in New York, it is considered that when ordinary conditions obtain, the annual loss from the yellows should be reduced to less than 1 per cent. per annum, where prompt and careful eradication is done."

This is a matter for the peach growers of New Jersey to consider. At the present time there is no organized method of eradication practiced. Individual growers are doing good inspection work in their own orchards, but this should be widespread to prevent yellows from establishing itself anywhere in the State.

#### **Suggestions for the Prevention and Control of Yellows and Little Peach.**

Select a well drained, favorable site for the peach orchard. Avoid lowlands and fields with low, wet, or "springy" places, even if such fields are at some elevation above the surrounding land level.

Purchase well grown nursery trees of a medium to large grade.† Avoid weak, poorly-grown trees and trees grown near an infested orchard.

Practice good orchard management in the form of proper cultivation and sufficient fertilization. Do not apply fertilizers to excess, especially nitrogenous manures.

See that the soil is well up around the trunks of the trees just before freezing weather in the late fall so that no excess of moisture will stand about the trees. This is especially important in young orchards upon the loamy soils of New Jersey.

---

\* Proc. 17th Annual Meeting Conn. Pom. Soc., 1908, p. 73.

† N. J. Expt. Sta. Bul. 219, pp. 9 and 10.



Never leave the bark of the roots exposed during the winter after removing borers in the fall.

Closely observe the behavior of each tree in the orchard from the beginning. If symptoms of yellows or little peach appear in any tree, pull it out at once and destroy it by burning. Do not allow an affected tree to remain in the orchard from fall until spring.

Individual trees which grow very poorly in a young orchard are of doubtful value whether affected with yellows or not and had best be pulled out and replaced by others. In certain special cases where the poor growth is known to be caused by such factors as scale or borers it may be better economy to leave the tree if it can be properly cared for.

Trees removed because of being affected with yellows or little peach in orchards from one to four or five years old may be replaced by nursery trees. It is of doubtful value in orchards much older than this as in many cases the filled in trees will make a poor growth because of the limiting effect of the surrounding trees.

Do not allow the peach tree to become weak in vigor because of lack of cultivation, fertilization and pruning, or lack of attention to borers, scale and leaf curl.

### **Summary.**

This bulletin is an appeal to the peach growers of the State to practice clean, intensive methods of orchard management and to eradicate all trees affected with yellows and little peach. It is considered appropriate at this time because the industry is gaining strength after the severe check administered by the San José scale, and because of the fact that the yellows and little peach diseases are prevalent to some degree throughout the State and neighboring States and are a menacing danger to the future welfare of the peach industry, especially if they are allowed to spread unchecked.

Yellows appeared about 1791 in the vicinity of Philadelphia and has since been more or less of a menace to the peach industry of the Atlantic coast states north of the Carolinas.

The exact cause of the disease is still unknown, but the opinion of investigators is divided principally between a germ theory and

an enzym theory. The effect of yellows appears to be caused by an interference with the normal nutrition of the tree.

The two prominent symptoms of yellows are as follows:

First. The premature ripening of the fruit which is usually characteristically red spotted and blotched. Such fruit is of poor quality, often insipid and sometimes bitter and especially subject to decay.

Second. A forced growth of slender, wiry shoots with narrow leaves, usually of a sickly yellowish-green color appearing upon the trunk or main branches. These shoots which may be described as in the form of water sprouts are much more slender than a normal growth and are frequently profusely branched. They sometimes make a late growth in the fall and may be conspicuous upon dormant trees.

The foliage of affected trees is commonly an unhealthy, yellowish-green color. However, in certain instances where the supply of available plant food and moisture is liberal the foliage may remain a dark-green.

Early stages of yellows can be detected by trained observers. The evidence is very strong that yellows and little peach are sometimes distributed in nursery trees. There is some indication that it may reach the nursery in the form of affected pits. It is definitely known that it can be transmitted by the process of budding.

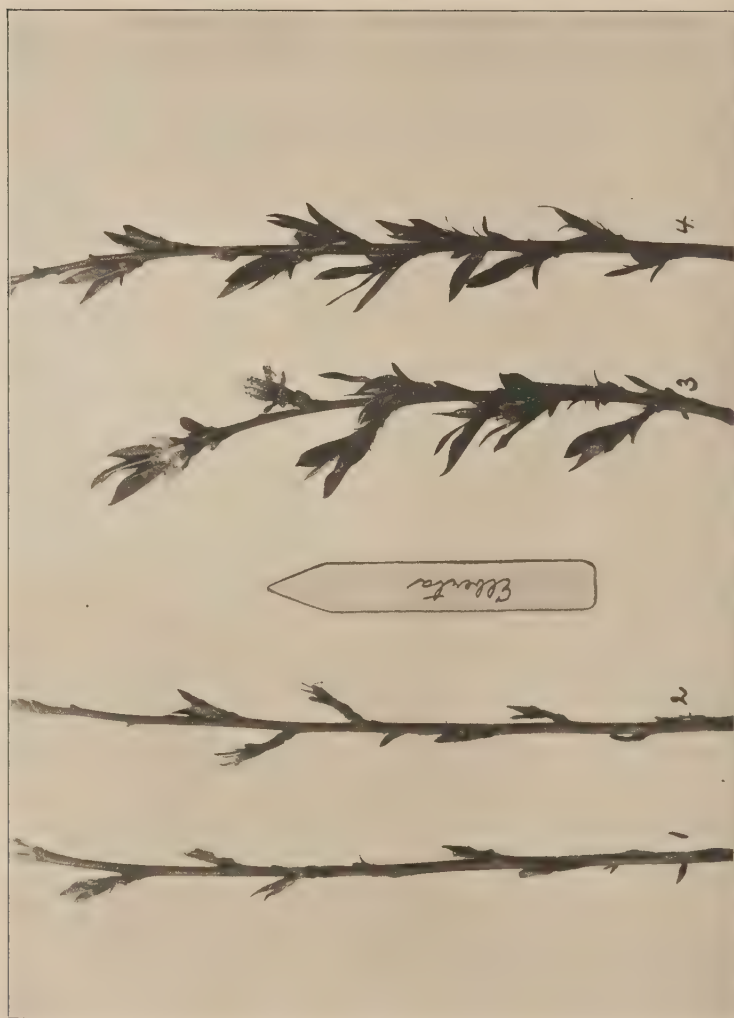
The cutting off of diseased branches does not prevent the spread of the disease to the apparently healthy remainder of the tree.

Overbearing, lack of cultivation and fertilization, dry seasons, wet seasons, borers, root aphid and leaf curl have at various times been considered as the cause of yellows. These are all believed to be indirect factors. Anything which reduces the vigor of an affected tree tends to bring out the prominent symptoms of the disease. If the trees are mechanically injured or weakened in any way the spread of the disease may possibly be favored also.

Several forms of winter injury are suffered by the peach. A mild form is the killing of the fruit buds in winter by low temperatures. In severe cases the twigs are killed back in addition to the destruction of the fruit buds. Severe heading in of the branches should follow such damage. This form of winter injury does not commonly occur in New Jersey. In certain seasons there may be some damage of this sort in the northern part of the State.



**FIG. 9.** Illustrates the same tree as in Fig. 8, but a little later in the season. The leaves have fallen from the girdled portion but still remain upon the normal branch.



**Fig. 10.** Twigs Nos. 1 and 2 were cut from a normal tree. Twigs Nos. 3 and 4 were cut from a tree which showed early symptoms of yellows the previous fall. Note that the development of the leaf and fruit buds on Twigs 3 and 4 is much in advance of that upon Twigs 1 and 2.





**Fig. 11.** A peach nursery between the rows of trees in a peach orchard. A bad practice from every standpoint.



**Fig. 12.** A peach tree in full bearing with one branch affected with yellows. The central branches (A) bore premature fruit. Note the thin foliage and rolled appearance of the leaves. The apparently healthy portion of the tree is still carrying its fruit.



**Fig. 13.** A Chinese stone peach tree the fourth summer after planting. It has behaved abnormally from the start and developed true symptoms of little peach in 1909. The photograph shows the rolled and drooped foliage.



**Fig. 14.** A Mountain Rose tree at the beginning of the fourth season. The growth has been short and upright each year. It produced "little peach" fruit in 1909. See page 20.





**Fig. 15.** Twigs Nos. 1 and 4 are from healthy trees. Twigs Nos. 2 and 3 are from trees affected with little poach. From the points (a) to the base the leaves upon Twigs Nos. 2 and 3 were shorter than normal leaves, were yellowish green in color and were slightly rolled and drooped. Above the points (c) the leaves were apparently normal in size and color.



**Fig. 16.** Illustration of normal and "little peach" leaves. Groups 3 and 4 are affected leaves. They are noticeably shorter and more rolled than the normal leaves, Nos. 1 and 2. All gradations of size between 1 and 2 and 3 and 4 can commonly be found upon an affected tree.

Another form of winter injury occurs to the bark of the trunk below the collar or the surface of the ground.

In severe cases, the tree is entirely girdled and dies in early spring. Only portions of the bark upon the trunk may be injured, however, and the tree partially girdled may grow normally until mid-summer when the leaves will roll and the fruit ripen prematurely. Such fruit is often of large size and more or less bitter. *It can be readily distinguished from premature fruit from yellows trees, however.*

Winter injury of this type is not infrequent in the northern counties of the State, and it occasionally occurs upon the sandy soils of southern New Jersey.

Upon exposed sites the soil is frequently pushed away from the base of the tree by its swaying about in strong winds. The tender bark of the root is then exposed to the weather.

Upon retentive soils, water often collects in the hole around the tree and the freezing and thawing process soon accomplishes injury.

If the soil should be dug away from the base of the trees in late fall, for the removal of borers, the root should not be left exposed during the winter.

It has been observed that yellows is especially likely to occur in low, wet places and in wet portions of even elevated sites, and that winter injured trees sometimes appear to be especially susceptible. The writer has believed that winter injury is probably an indirect factor similar to lack of moisture and lack of fertilization. But whether winter injury should finally be proved to be an indirect or a direct factor differs in importance only in degree.

In either case, winter injury should be prevented as far as possible by the selection of a proper site, by the mounding of soil about the base of the tree in late fall at least upon retentive soils, and by the use of cover crops.

Little peach is a disease somewhat similar to yellows that has made its appearance comparatively recently.

It is as much to be feared as yellows and even appears to spread more rapidly. Complete destruction of the tree commonly occurs in a shorter space of time.

The cause of little peach is yet to be determined although it appears to be of a nature similar to yellows.

Little peach differs from yellows in several particulars:

The fruit remains small in size and frequently ripens ten days later than normal fruit of the same variety, which is an opposite effect to the prematuring caused by yellows. Trees affected with little peach seldom show any of the forced slender, wiry shoots that are commonly seen upon yellows trees. Early stages of little peach are difficult to distinguish from early stages of yellows.

Yellows and little peach can be classed together when the matter of their prevention and control is considered.

Briefly, to prevent serious damage by these diseases:

Select as favorable sites as possible for the peach orchards, and avoid low, or wet, ground, even if the latter is at some elevation.

Secure healthy, well grown nursery trees.

Practice good cultivation, reasonable fertilization, and the necessary pruning and spraying to promote a vigorous normal growth.

Closely observe the behavior of all trees and be prompt to destroy any that show indications of disease.

The peach industry of the State is now recovering from the severe check caused by the scale. It is to be hoped that it will develop upon a better and stronger basis than ever before and that the periodical disasters of the past will be eliminated.





